

SOME CAUSES AND EFFECTS OF VARIATION IN THE
RANGE OF TEMPERATURE.

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The present joint paper contains the results of a discussion of some of the more salient meteorological aspects of a variation in the range of air temperature. The investigation was instituted with the primary object of determining what variation, if any, of the diurnal curve of barometric pressure might accompany a greater or less range of temperature as night followed day; but other points had necessarily to be considered so that we might be able to assign as nearly as possible the position of the range curve in the sequence of meteorological cause and effect. We have, however, adhered to our original intention of making the range of temperature the basis of the argument.

The meteorological elements taken into account here are the monthly means of :—

1. The diurnal range of air temperature ;
2. The maximum temperature of the air ;
3. The minimum temperature of the air ;
4. The hourly mean temperature of the day ;
5. The range of dew-point temperature from VIII. to XIV. ;
6. The hourly mean dew-point temperature ;
7. The range of relative humidity from VIII. to XIV. ;
8. The hourly mean relative humidity ;
9. The range of barometric pressure from VIII. to XIV. ;
10. The hourly mean pressure ;
11. The mean percentage of sunshine ;
12. The mean percentage of cloud derived mainly from six observations
a day ;
13. The mean rainfall ;
14. The total rainfall in the period studied.

For each given month the month's mean values of each of these elements are arranged according to the magnitude of the range of temperature in any year 1897 to 1910, some months of 1911 having been included. The method of arrangement will be followed in Table 1, showing the results for one month, *i.e.*, July, of which it is perhaps only necessary to say that the *minus* sign in the dew-point column indicates that the vapour pressure is less at VIII. o'clock than it is at XIV.; the *plus* sign when it occurs—in other months—that the vapour pressure is greater at XIV.

Table 2 gives for the year corresponding information to that which Table 1 gives for the month; the "A" line, of the year, containing for each column the averages of the "A" lines of each month; and so on for the "B," "C," "D," ... lines. The numbers in each column of Table 2 have, however, first of all been smoothed in threes by Bloxam's method.

Table 2 would seem to be of peculiar interest. With one exception all the elements in question respond to the rise and fall of the range of temperature curve. The following *increase* more or less regularly as the mean monthly range of temperature increases:—

2. The maximum temperature;
4. The mean temperature;
9. The range of pressure;
11. The duration of sunshine.

The following *decrease* more or less regularly as the range of temperature increases:—

3. The minimum temperature;
5. The range of the dew-point;
6. The mean dew-point;
7. The range of relative humidity;
8. The mean humidity;
12. The cloudiness of the sky;
13. The mean rainfall;
14. The number of rainy days in a month.

The one exception is the mean pressure of the month, which commences by falling, but concludes by rising as the range of temperature increases in magnitude. Whether this anomalous behaviour of the

monthly value of mean pressure arises physically or fortuitously is not yet clear.

The general tendency of some of the results given in Table 2 is perhaps what would have been expected. Thus, *e.g.*, we should expect that the greater cloudiness of the sky, the heavier rainfall, and the greater number of rainy days in any given month would go with a diminished percentage of sunshine. It is not so obvious, however, that these should also go with a uniform decrease of both maximum and mean temperature and an increase of both minimum temperature and range of temperature, especially when it is remembered that some of the hottest Kimberley summer days are to a greater or less extent characterised by clouded skies. Nor does it necessarily follow, as a mere piece of intellectual reasoning, that the range of dew-point temperature, or the range of relative humidity, should increase as the range of temperature decreases. In any case, whether the results are, or are not, much as might be expected, the actual measures are of interest. In particular, the mutual relationship of sunshine and cloud is worth attention. It will be seen that the sum of the percentages of sunshine and of cloud is not a constant quantity, but that it becomes greater as the range of temperature becomes less, rising from a total of 106 per cent. when the range of temperature is $32^{\circ}6$ to a total of 114 per cent. when the range of temperature is $24^{\circ}3$.

The minimum temperature does not rise at the same rate as the maximum temperature falls in the interval between the average month's greatest range of temperature to its least. Thus it comes about that the average month of least range of temperature is also the average month of least mean temperature. This is important. Professor Haughton's lectures have been quoted as teaching that the mildness of the climate of the West of Ireland is due to the abundant rainfall. It has been suggested that this mildness of temperature is a direct consequence of the heat disengaged in the process of condensation from aqueous vapour to rain. The suggestion does not hold water. The Kimberley results show that although the nights are a little warmer in the wet months the days are colder by a greater number of degrees. That is to say, whatever the "blanketing" action of the clouds may be, or whatever the quantity of heat disengaged in the process of condensation, the radiation that is checked by, and the latent heat that is received from the clouds, are together less than the direct solar heat that is shut off by the clouds from the earth's surface.

During the winter months the diurnal curve of dew-point temperature is quite unlike what it is in the summer. In the winter half-year, April to September, the vapour tension is higher at XIV. than it is at VIII., whereas for the rest of the year the case is the other way about. A sepa-

ration of the winter and summer parts of column (5) of Table 2 gives us the following result :—

RANGE OF MONTHLY DEW-POINT TEMPERATURE COMPARED WITH
MONTHLY RANGE OF TEMPERATURE.

	Winter.	Summer.
A	—3·4 ^o	+1·9 ^o
B	3·3	2·1
C	3·1	2·2
D	3·1	2·3
E	2·8	2·7
F	2·8	3·0
G	2·6	2·8
H	2·6	2·8
I	2·5	2·7
J	2·5	2·8
K	2·2	2·7
L	1·7	2·5
M	1·5	2·4
N	1·6	2·2

giving the curious result that in the winter half-year the diurnal variation in the total moisture content of the lower air diminishes as the air becomes damper, whereas in the summer half-year the corresponding variation is less both when the sky is very clear and when it is very cloudy—an intermediate state of things with regard to the sky (and of course with regard to the range of temperature) giving the greatest range of dew-point from VIII. to XIV. o'clock. Summer and winter taken together obliterate this purely summer effect. The relative humidity has no similar analogue.

The only other question discussed in this paper is the effect of a variation in the range of temperature upon the harmonic constants in the diurnal curves of temperature and barometric pressure.

For any given month arranged as in Table 1, the first five lines A—E, and the last five J—N, are taken, and the mean diurnal curves of temperature and barometric pressure of each for the given month for the years which happen to fall in these respective two sets are computed. Thus, for example, the mean diurnal curves of temperature and barometric pressure for July for the years 1898, 1902, 1901, 1897, and 1906 are computed for the greater range of temperature (which here averages 32°·5); and the same two elements for the same month for the years 1909, 1910, 1908, 1900, and 1899, are computed for the lesser range of temperature (which here averages 27°·0).

The constants of the first three harmonic terms in the diurnal curves of barometric pressure (deduced as above) for the greater, and for the less, ranges of temperature are set forth in Tables 3 and 4 respectively. It appears from these Tables that a difference in the monthly mean range of temperature makes no material difference in the phase times of either the 24-hour wave (V_1), the 12-hour wave (V_2), or the 8-hour wave (V_3). The amplitudes (u_1, u_2, u_3) are nevertheless more or less dependent upon the range of temperature, besides depending—the first and third in particular—upon the time of year.

The following are the ratios, $ua/u\beta$, of the amplitudes pertaining to the greater range of temperature to those pertaining to the lesser range:—

	$\frac{M-m}{a-\beta}$	$\frac{u_1}{a/\beta}$	$\frac{u_2}{a/\beta}$	$\frac{u_3}{a/\beta}$
Jan.	^o 6.1	1.224	.996	1.000
Feb.	6.1	1.273	1.142	1.909
Mar.	5.4	1.132	1.055	.923
April.....	6.5	1.075	.967	.976
May	7.5	1.263	.988	1.315
June	3.7	1.177	.958	1.074
July	5.5	1.135	1.041	1.071
Aug.	3.1	1.153	.983	1.196
Sept.	5.5	1.189	1.024	0.794
Oct.	4.4	1.074	1.047	10.000
Nov.	3.9	1.051	1.063	1.611
Dec.	3.1	1.022	.941	1.471
Year	5.1	1.139	1.015	1.162

Judging by Tables 3 and 4 the direct dependence of the second and third harmonic terms upon the range of temperature must be slight at the best. On account of its regularity the ratio a/β given above is much more satisfactory for the first harmonic term than it is for the other two. Averages for all the months in which $a-\beta$ exceeds its mean value ($=5^{\circ}.1$) or falls short of it are:—

No. of Cases.	$\frac{M-m}{a-\beta}$	$\frac{u_1}{a/\beta}$	$\frac{u_2}{a/\beta}$
7	^o 6.2	1.184	1.030
5	3.8	1.095	.998

It appears from this that the greater the difference between the ranges of temperature for any month given in Tables 3 and 4, then the greater the ratio of α to β on the whole for both of the first two harmonic terms. No great faith can be placed upon the result for the second harmonic term, though. At the same time the ratio is suggestive, and should it be confirmed by a longer series of observations, we should have to conclude that some portion of the second harmonic term of pressure is of local origin.

The phase times of the harmonic terms of temperature, given in Tables 5 and 6, are also practically unaffected whether the range of temperature be greater or less. The amplitudes, however, are rather more modified, than those of pressure. The following are the α/β ratios :—

	$\frac{M-m}{\alpha-\beta}$	$\frac{u_1}{\alpha/\beta}$	$\frac{u_2}{\alpha/\beta}$	$\frac{u_3}{\alpha/\beta}$
Jan.	6.1	1.295	1.246	1.431
Feb.	6.1	1.261	1.305	1.322
Mar.	5.4	1.270	1.196	1.525
April.	6.5	1.333	1.197	1.961
May	7.5	1.409	1.386	1.856
June	3.7	1.149	1.063	1.611
July	5.5	1.269	1.171	1.004
Aug.	3.1	1.134	1.126	1.257
Sept.	5.5	1.218	1.271	1.400
Oct.	4.4	1.198	1.195	1.171
Nov.	3.9	1.160	.982	1.597
Dec.	3.1	1.143	1.112	1.118
Year	5.1	1.230	1.184	1.386

The ratios evidently depend fairly closely upon the value of $\alpha-\beta$, the first term more so than the other two do. A summary is :—

No. of Cases.	$\frac{M-m}{\alpha-\beta}$	$\frac{u_1}{\alpha/\beta}$	$\frac{u_2}{\alpha/\beta}$	$\frac{u_3}{\alpha/\beta}$
7	6.2	1.294	1.253	1.500
5	3.8	1.157	1.096	1.351

That is to say, the ratios of the amplitudes are greater when $\alpha-\beta$ is greater.

The amplitudes u_i , in Tables 5 and 6, may be approximately represented by the formula—

$$u_i = \cdot 42(M-m).$$

From some points of view the harmonic constants look better when computed for the "temperature variability," *i.e.*, for the curve of change of temperature from hour to hour, than they do when they are computed for the hourly temperatures. The harmonic constants in the diurnal curves of temperature variability, or, if we prefer to call it so, in the $\Delta\theta/\Delta t$ curve—where θ is the temperature and t the time counted from midnight—are given in Tables 7 and 8. The angles V_1, V_2, V_3 in this case of course differ by $\pi/2$ from those of Tables 5 and 6. The ratios of the amplitudes of temperature variability to those of temperature, for both greater and lesser ranges of temperature, are approximately—

$$u_1 = 3\cdot 8; u_2 = 1\cdot 9; u_3 = 1\cdot 3.$$

The respective ratios of the amplitudes of temperature variability for the greater ranges of temperature (α) to the amplitudes for the lesser ranges (β) are the same as those of temperature.

One advantage of working out the harmonic constants for the variability is that they bring into strong relief the fact that the phase times of the three principal waves, given in Tables 7 and 8, group themselves closely about the phase time of the 12-hour wave of pressure. In fact, all three of the variability component waves come to a maximum within about an hour or less of the time of a maximum of the pressure wave in question. This near coincidence of phase times in the first place, next the tendency which the phase times of the first and second harmonic components of temperature variability as well as the second component of barometric pressure show to come earlier in the day during the spring and early summer months; thirdly, the greater magnitude of the amplitude of the variability curve as well as of the second harmonic component of pressure at the same period; these go to support the idea that the 12-hour pressure wave arises initially as the result of the variation of temperature from instant to instant, and not as a result of temperature alone. Obviously the mere expansion of the air upwards could have no effect upon the pressure beneath, excepting by virtue of the reaction downwards, and this last must be greatest when the upward acceleration of the air is a maximum, *i.e.*, when $d\theta/dt$ is a maximum.*

* See a remarkable paper by Halm published in the *Journal* of the Scottish Meteorological Society, Third Series, No. XXII., 1906. Also Sutton, "The Diurnal Variation of Barometric Pressure," *Report S.A.A.A.S.*, 1906. Hann has yet another able paper, "Ueber die Zerlegung des komplexen taeglichen Ganges der Temperatur und des Luftdruckes in eine ganz- und eine halbtägige Welle," in *Met. Zeit.*, July, 1911.

Tables 9 and 10 give the hourly mean barometric pressures at 32° F. They are obtained from the records of the photobarograph, and have been reduced to agree with the control readings of the Observatory Standard Barometer. Table 9 contains the mean results for the greater ranges of temperature (α), and Table 10 those for the lesser ranges (β).

Tables 11, 12, give the hourly mean temperatures for the greater (α) and lesser (β) ranges of temperature respectively.

TABLE 1.—COMPARISON OF METEOROLOGICAL ELEMENTS (MONTH).

JULY.	AIR TEMPERATURE.			TEMPERATURE OF THE DEW-POINT.		RELATIVE HUMIDITY.		PRESSURE.		SUN-SHINE.	CLOUD.	RAINFALL.	
	Range.	Maximum.	Minimum.	Mean.	Range.	Mean.	Range.	Mean.	Range.	Mean.	Mean.	Total.	Total.
A	32.9	65.6	32.7	47.4	0	28.4	29.2	50.1	Inch. .074	Inch. 26.266	% 92	Inch. .055	Days. 1
B	32.8	68.4	35.6	50.1	-4.4	33.2	36.4	55.5	.072	.238	87	.125	1
C	32.6	65.8	33.2	47.7	-6.6	29.8	32.4	55.6	.070	.267	89	.010	1
D	32.3	67.6	35.3	49.7	-5.0	33.1	35.9	56.3	.072	.213	91	—	—
E	32.1	66.4	34.3	48.6	-6.7	29.0	27.3	48.8	.062	.289	90	.000	0
F	31.8	67.2	35.4	49.4	-6.0	31.4	32.4	52.2	.071	.235	83	.090	2
G	31.6	67.5	35.9	50.0	-6.8	31.1	29.8	50.4	.070	.269	82	.000	0
H	31.1	68.8	37.6	51.5	-5.9	32.0	29.6	49.4	.071	.327	91	—	—
I	30.3	65.7	35.4	49.2	-5.8	31.4	29.6	49.4	.062	.331	85	—	—
J	29.3	65.9	36.6	50.0	-4.9	33.9	34.5	56.6	.063	.285	82	.000	0
K	29.1	64.9	35.8	49.2	-6.2	33.7	28.1	58.1	.063	.230	77	.525	5
L	27.3	64.9	37.7	49.8	-4.0	35.1	32.2	60.4	.062	.305	81	.730	6
M	25.2	63.4	38.2	49.5	-3.9	38.2	32.6	68.3	.070	.206	79	1.605	4
N	24.1	62.2	38.1	49.1	-3.0	38.7	32.1	70.6	.060	.257	74	.935	9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(13)	(14)

TABLE 2.—COMPARISON OF METEOROLOGICAL ELEMENTS (YEAR).

	Range of Temp.	Maximum Temp.	Minimum Temp.	Mean Temp.	Range of Dew-point Temp.	Mean Dew-point Temp.	Range of Relative Humidity.	Mean Relative Humidity.	Range of Pressure.	Mean Pressure.	Mean Sunshine.	Mean Cloud.	Mean Rainfall.	Total Rain-fall.
A	32.6	80.6	48.0	63.6	0	39.0	24.4	44.2	Inch. .078	Inch. 26.137	% 85	% 21	Inch. .311	Days. 33
B	32.0	80.7	48.6	63.8	-0.7	40.1	24.7	46.2	.078	.137	84	22	.695	46
C	31.5	80.6	49.1	63.9	-0.5	40.9	25.0	47.4	.078	.137	83	25	.836	55
D	31.0	80.0	49.0	63.6	-0.4	41.1	24.8	48.2	.078	.135	82	26	.848	58
E	30.6	79.6	49.1	63.4	-0.1	41.4	25.3	49.1	.077	.128	80	28	.998	68
F	30.1	79.3	49.2	63.2	+0.1	41.8	25.3	50.1	.076	.126	80	29	1.201	69
G	29.6	79.4	49.8	63.7	+0.1	42.5	25.1	50.5	.076	.126	79	30	1.361	67
H	29.1	79.2	50.1	63.7	+0.1	43.0	25.0	51.0	.076	.136	80	30	1.454	66
I	28.4	78.7	50.0	63.6	+0.1	43.6	25.3	52.4	.074	.136	79	31	1.429	75
J	27.9	77.9	49.8	63.0	+0.1	44.1	25.7	54.5	.073	.138	77	33	1.553	87
K	27.2	77.4	50.0	62.8	+0.2	44.6	26.1	56.0	.073	.133	76	36	1.633	90
L	26.6	76.8	50.2	62.5	+0.4	45.1	26.4	57.6	.073	.135	75	38	2.026	99
M	25.6	76.0	50.4	62.2	+0.5	46.0	26.6	60.2	.071	.135	74	39	2.434	108
N	24.3	74.8	50.6	61.5	+0.3	47.0	26.2	63.4	.069	.137	72	42	3.086	120
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)

TABLE 3.

HARMONIC CONSTANTS IN THE DIURNAL CURVES OF BAROMETRIC PRESSURE.

α. For Greater Ranges of Temperature.

	Range of Temperature.	u_1 .	u_2 .	u_3 .	V_1 .	V_2 .	V_3 .
	°	inch	inch	inch	°	°	°
Jan.....	30·2	·0383	·0277	·0051	360	153	187
Feb.....	30·2	·0364	·0265	·0021	359	151	182
Mar.	28·6	·0295	·0267	·0012	357	155	345
April	29·5	·0228	·0260	·0040	350	159	10
May.....	31·1	·0235	·0255	·0071	353	157	355
June	30·5	·0234	·0251	·0073	347	156	353
July	32·5	·0269	·0254	·0075	351	154	356
Aug.	34·1	·0301	·0283	·0061	350	157	2
Sept.	34·8	·0327	·0306	·0027	2	165	21
Oct.....	32·7	·0350	·0290	·0010	5	168	91
Nov.	33·2	·0373	·0271	·0029	3	164	173
Dec.	30·3	·0370	·0240	·0050	1	161	183
Year	31·5	·0311	·0268	·0043	356	158	—

TABLE 4.

HARMONIC CONSTANTS IN THE DIURNAL CURVES OF BAROMETRIC PRESSURE.

β. For Lesser Ranges of Temperature.

	Range of Temperature.	u_1 .	u_2 .	u_3 .	V_1 .	V_2 .	V_3 .
	°	inch	inch	inch	°	°	°
Jan.	24·1	·0313	·0278	·0051	359	157	178
Feb.	24·1	·0286	·0232	·0011	351	154	194
Mar.	23·2	·0260	·0253	·0013	357	152	16
April	23·0	·0212	·0269	·0041	350	154	7
May	23·6	·0186	·0258	·0054	356	160	356
June	26·8	·0199	·0262	·0068	348	160	346
July	27·0	·0237	·0244	·0070	351	154	357
Aug.	31·0	·0261	·0288	·0051	358	157	355
Sept.	29·3	·0275	·0299	·0034	3	166	12
Oct.....	28·3	·0326	·0277	·0001	4	166	95
Nov.	29·3	·0355	·0255	·0018	4	166	167
Dec.	27·2	·0362	·0255	·0034	2	157	183
Year	26·4	·0273	·0264	·0037	357	158	—

TABLE 5.

HARMONIC CONSTANTS IN THE DIURNAL CURVES OF TEMPERATURE.

a. For Greater Ranges of Temperature.

	Range of Temperature.	u_1 .	u_2 .	u_3 .	V_1 .	V_2 .	V_3 .
	°	°	°	°	°	°	°
Jan.	30·2	12·384	2·022	1·212	231	81	30
Feb.	30·2	12·555	2·503	1·134	229	68	20
Mar.	28·6	12·325	2·851	1·098	229	61	19
April	29·5	12·690	3·532	·896	230	62	12
May	31·1	13·352	4·566	·464	231	57	343
June ...	30·5	12·822	4·498	·290	229	53	292
July	32·5	14·247	4·566	·280	230	52	328
Aug.	34·1	14·771	4·214	·818	229	55	23
Sept.	34·8	15·198	3·544	1·296	230	65	29
Oct.....	32·7	14·000	2·598	1·280	231	78	43
Nov.	33·2	13·965	1·990	1·623	233	95	52
Dec.	30·3	12·645	1·822	1·245	232	85	36
Year	31·5	13·413	3·225	·970	230	68	12

TABLE 6.

HARMONIC CONSTANTS IN THE DIURNAL CURVES OF TEMPERATURE.

β. For Lesser Ranges of Temperature.

	Range of Temperature.	u_1 .	u_2 .	u_3 .	V_1 .	V_2 .	V_3 .
	°	°	°	°	°	°	°
Jan.	24·1	9·565	1·623	·847	234	78	26
Feb.	24·1	9·954	1·918	·858	230	62	30
Mar.	23·8	9·704	2·384	·720	233	60	22
April	23·0	9·522	2·952	·457	232	58	13
May	23·6	9·477	3·294	·250	231	54	354
June	26·8	11·158	4·233	·179	230	56	302
July	27·0	11·223	3·898	·279	228	53	336
Aug.	31·0	13·031	3·742	·651	228	53	12
Sept.	29·3	12·476	2·789	·926	231	63	28
Oct.....	28·3	11·686	2·174	1·102	233	74	41
Nov.	29·3	12·041	2·026	1·016	235	87	46
Dec.	27·2	11·065	1·639	1·114	233	83	39
Year	26·4	10·909	2·723	·700	231	65	14

TABLE 7.

HARMONIC CONSTANTS IN THE DIURNAL CURVES OF TEMPERATURE
VARIABILITY.*a.* For Greater Ranges of Temperature.

	Range of Temperature.	u_1 .	u_2 .	u_3 .	V_1 .	V_2 .	V_3 .
	°	°	°	°	°	°	°
Jan.	30·2	3·233	1·046	·927	321	172	120
Feb.	30·2	3·277	1·294	·864	319	158	109
Mar.	28·6	3·218	1·444	·840	319	150	109
April	29·5	3·313	1·828	·685	320	152	102
May	31·1	3·486	2·310	·357	321	147	73
June	30·5	3·348	2·356	·222	319	143	22
July	32·5	3·719	2·364	·218	320	142	58
Aug.	34·1	3·800	2·246	·711	319	144	113
Sept.	34·8	3·968	1·836	·992	320	155	119
Oct.	32·7	3·655	1·338	·980	321	168	133
Nov.	33·2	3·645	1·030	1·242	323	185	141
Dec.	30·3	3·308	·950	·946	322	174	126
Year	31·5	3·498	1·670	·749	320	158	102

TABLE 8.

HARMONIC CONSTANTS IN THE DIURNAL CURVES OF TEMPERATURE
VARIABILITY.*β.* For Lesser Ranges of Temperature.

	Range of Temperature.	u_1 .	u_2 .	u_3 .	V_1 .	V_2 .	V_3 .
	°	°	°	°	°	°	°
Jan.	24·1	2·497	·845	·668	324	167	117
Feb.	24·1	2·599	·990	·657	320	152	120
Mar.	23·2	2·530	1·234	·552	323	150	112
April	23·0	2·486	1·528	·349	322	147	103
May	23·6	2·473	1·705	·198	321	145	84
June	26·8	2·913	2·190	·137	320	146	32
July	27·0	2·930	2·018	·207	318	143	65
Aug.	31·0	3·402	1·952	·498	318	142	102
Sept.	29·3	3·257	1·445	·709	321	153	118
Oct.	28·3	3·098	1·128	·843	323	164	131
Nov.	29·3	3·144	1·049	·778	325	177	136
Dec.	27·2	2·926	·848	·853	323	173	129
Year	26·4	2·855	1·411	·537	321	155	104

TABLE 9.
HOURLY MEAN BAROMETRIC PRESSURES AT 32° F.
α. For Greater Ranges of Temperature.

Hour.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Midnight	inch. 26·032	inch. 26·063	inch. 26·081	inch. 26·158	inch. 26·237	inch. 26·278	inch. 26·263	inch. 26·259	inch. 26·183	inch. 26·088	inch. 26·048	inch. 26·042
I.	·026	·061	·076	·156	·234	·276	·262	·256	·179	·081	·042	·037
II.	·021	·058	·073	·152	·231	·274	·257	·251	·173	·074	·039	·034
III.	·020	·055	·067	·145	·226	·272	·256	·247	·167	·073	·038	·035
IV.	·025	·057	·070	·146	·225	·270	·253	·247	·173	·077	·044	·044
V.	·036	·064	·077	·153	·228	·272	·256	·253	·181	·089	·056	·055
VI.	·052	·079	·089	·163	·237	·282	·265	·266	·196	·106	·072	·070
VII.	·066	·093	·102	·177	·250	·294	·279	·281	·212	·120	·084	·080
VIII.	·069	·101	·114	·194	·266	·311	·293	·297	·224	·126	·089	·083
IX.	·066	·101	·117	·201	·276	·323	·305	·306	·227	·127	·087	·079
X.	·062	·096	·115	·198	·277	·326	·307	·307	·221	·118	·078	·070
XI.	·051	·084	·103	·188	·266	·314	·298	·295	·205	·099	·064	·061
Noon	·033	·066	·086	·168	·244	·292	·272	·269	·179	·079	·044	·043
XIII.	·014	·047	·062	·143	·216	·266	·244	·240	·152	·056	·023	·024
XIV.	25·991	·025	·041	·124	·196	·244	·223	·217	·131	·034	·002	·004
XV.	·972	·007	·025	·117	·188	·235	·214	·206	·120	·020	25·987	25·993
XVI.	·958	25·997	·021	·115	·187	·235	·212	·204	·118	·018	·979	·977
XVII.	·953	·993	·024	·116	·192	·240	·216	·208	·123	·022	·980	·977
XVIII.	·964	26·000	·031	·125	·202	·250	·225	·216	·133	·034	·991	·987
XIX.	·982	·017	·044	·136	·215	·257	·236	·228	·150	·051	26·007	26·002
XX.	26·004	·038	·063	·150	·224	·268	·246	·242	·169	·070	·026	·020
XXI.	·021	·054	·075	·158	·231	·274	·253	·250	·180	·080	·041	·035
XXII.	·032	·062	·080	·163	·235	·279	·258	·255	·185	·087	·051	·046
XXIII.	·035	·065	·083	·163	·235	·281	·262	·257	·185	·087	·052	·048
Month	26·020	26·053	26·072	26·155	26·230	26·276	26·256	26·252	26·174	26·076	25·039	26·035
M - m =	30·2	30·2	28·6	29·5	31·1	30·5	32·5	34·1	34·8	32·7	33·2	30·3

TABLE 10.
HOURLY MEAN BAROMETRIC PRESSURES AT 32° F.
β. For Lesser Ranges of Temperature.

Hour.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Midnight	inch. 26·036	inch. 26·068	inch. 26·104	inch. 26·165	inch. 26·205	inch. 26·304	inch. 26·266	inch. 26·195	inch. 26·155	inch. 26·107	inch. 26·076	inch. 26·035
I.	·029	·064	·102	·161	·204	·302	·263	·191	·149	·100	·068	·029
II.	·023	·060	·095	·156	·198	·299	·260	·186	·141	·096	·065	·024
III.	·020	·058	·090	·149	·192	·297	·255	·181	·137	·092	·066	·024
IV.	·026	·060	·089	·148	·191	·296	·253	·180	·138	·097	·071	·029
V.	·040	·068	·095	·153	·195	·298	·255	·186	·148	·106	·083	·040
VI.	·052	·082	·108	·162	·205	·308	·265	·197	·162	·123	·097	·054
VII.	·064	·095	·121	·178	·217	·321	·278	·210	·176	·137	·109	·067
VIII.	·068	·103	·132	·196	·233	·335	·291	·225	·190	·144	·114	·070
IX.	·067	·104	·136	·203	·242	·348	·303	·234	·193	·144	·111	·067
X.	·064	·101	·134	·203	·243	·352	·307	·234	·188	·136	·103	·063
XI.	·053	·092	·124	·194	·231	·341	·295	·222	·174	·120	·089	·051
Noon	·038	·079	·108	·174	·211	·319	·274	·199	·149	·099	·070	·034
XIII.	·021	·060	·087	·149	·185	·291	·246	·171	·124	·079	·049	·014
XIV.	·001	·040	·067	·131	·168	·271	·228	·149	·104	·058	·027	25·993
XV.	25·985	·026	·054	·122	·160	·264	·219	·138	·095	·043	·016	·977
XVI.	·973	·016	·048	·119	·160	·265	·218	·138	·089	·042	·009	·965
XVII.	·973	·014	·049	·120	·166	·270	·221	·141	·100	·045	·012	·965
XVIII.	·979	·024	·057	·127	·176	·280	·229	·153	·112	·055	·023	·976
XIX.	·997	·036	·069	·140	·190	·292	·240	·168	·128	·072	·037	·991
XX.	26·012	·049	·087	·156	·200	·302	·251	·181	·142	·090	·053	26·009
XXI.	·029	·061	·097	·163	·206	·308	·256	·190	·153	·101	·068	·036
XXII.	·041	·068	·103	·168	·210	·312	·262	·197	·156	·106	·076	·036
XXIII.	·043	·069	·106	·169	·210	·313	·262	·199	·156	·108	·076	·038
Month	26·026	26·062	26·094	26·159	26·200	26·304	26·258	26·186	26·144	26·096	26·065	26·024
M - m =	24·1	24·1	23·2	23·0	23·6	26·8	27·0	31·0	29·3	28·3	29·3	27·2

TABLE 11.

HOURLY MEAN TEMPERATURES.

a. For Greater Ranges of Temperature.

Hour.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Midnight.....	68.1	69.1	62.5	54.5	48.8	41.4	40.8	45.6	53.0	58.2	61.8	67.1
I.	66.7	67.6	61.3	53.4	47.7	40.5	39.6	44.4	51.7	56.8	60.1	65.7
II.	65.5	66.2	60.2	52.3	46.5	39.5	38.5	42.9	50.2	55.1	58.4	64.4
III.	64.3	65.4	59.4	51.3	45.7	38.7	37.7	42.0	49.0	53.9	57.1	63.3
IV.	63.3	64.4	58.5	50.4	44.8	37.8	37.0	41.0	47.9	53.0	55.9	62.4
V.	62.4	63.6	57.6	49.6	43.9	37.1	36.3	40.3	46.9	51.8	54.8	61.4
VI.	63.0	63.1	56.7	48.7	43.2	36.5	35.9	39.4	46.0	52.2	57.5	63.6
VII.	68.6	67.1	58.9	49.5	42.8	35.9	35.4	39.6	49.1	57.9	64.2	68.7
VIII.	73.7	72.7	65.7	56.7	48.6	40.3	40.3	47.0	58.0	64.6	69.9	73.4
IX.	77.7	77.5	70.8	63.2	56.8	48.1	48.7	54.7	63.9	69.3	74.0	77.6
X.	81.2	81.6	74.8	67.6	62.2	53.7	54.6	59.9	68.8	73.1	77.4	81.1
XI.	84.3	84.9	77.9	71.1	66.3	58.0	59.3	64.3	72.5	76.4	80.2	84.2
Noon	86.3	87.3	80.2	73.5	69.2	60.9	62.3	67.1	75.3	78.5	82.2	86.0
XIII.	87.7	89.0	82.0	74.9	71.1	63.2	64.7	69.3	77.3	80.4	83.3	87.3
XIV.	88.1	89.1	82.7	75.6	73.0	64.2	65.8	70.5	78.1	81.1	83.9	87.4
XV.	87.7	89.0	82.7	75.6	72.0	64.4	66.0	70.8	78.2	81.1	84.4	87.3
XVI.	86.7	87.9	82.1	75.0	70.7	63.1	64.9	70.1	77.2	80.0	83.4	86.5
XVII.	85.2	86.4	79.8	71.7	64.9	56.7	59.3	66.4	74.4	77.6	81.4	84.9
XVIII.	82.7	83.3	75.7	65.7	59.0	51.5	52.6	58.8	68.1	73.0	77.7	82.1
XIX.	78.5	78.8	71.5	62.6	56.4	48.8	49.4	54.9	63.6	68.8	73.1	77.9
XX.	75.3	75.7	68.9	60.6	54.3	47.2	47.4	52.4	61.0	66.2	70.1	74.5
XXI.	73.0	73.4	66.7	58.8	52.6	45.5	45.5	50.3	58.3	64.0	67.6	72.1
XXII.	71.2	71.8	65.2	57.3	51.1	44.1	43.8	48.9	56.5	61.9	65.5	70.3
XXIII.	69.6	70.4	63.8	55.7	49.8	42.7	42.3	47.6	55.2	60.2	63.8	68.6
Month	75.5	76.1	69.4	61.5	55.8	48.3	48.7	53.6	61.7	66.5	70.3	74.9

TABLE 12.
HOURLY MEAN TEMPERATURES.
β. For Lesser Ranges of Temperature.

Hour.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Midnight.....	67·9	65·7	62·6	57·6	48·0	44·4	43·8	46·6	52·7	57·4	62·1	66·0
I.	67·0	64·7	61·7	56·8	47·2	43·5	42·7	45·5	51·6	56·1	60·9	65·0
II.	66·1	63·8	60·9	56·0	46·3	42·4	41·8	44·6	50·7	55·1	59·8	63·9
III.	65·5	63·1	60·4	55·3	45·8	41·6	41·0	43·7	49·8	54·4	58·9	62·9
IV.	64·9	62·5	59·8	54·8	45·2	40·8	40·2	42·9	49·1	53·5	57·9	62·0
V.	64·1	61·8	59·3	54·2	44·6	40·0	39·5	42·0	48·4	52·7	56·9	61·1
VI.	64·9	61·6	58·7	53·7	44·0	39·4	39·1	41·2	47·8	53·1	59·0	62·6
VII.	69·0	65·0	60·6	54·1	43·7	39·0	38·3	41·2	50·4	58·0	64·5	67·8
VIII.	72·6	69·2	65·7	59·1	48·0	42·8	42·2	47·8	57·1	63·2	69·0	72·0
IX.	75·8	72·5	69·6	63·9	53·4	50·0	49·4	54·3	62·0	67·2	72·7	75·3
X.	78·7	75·8	72·8	67·3	57·2	55·1	54·2	59·1	66·0	70·7	76·3	78·2
XI.	81·2	78·5	75·5	70·1	60·1	58·6	57·8	62·9	69·1	73·5	78·9	80·9
Noon	82·8	80·3	77·5	72·2	62·3	61·3	60·5	65·6	71·5	75·3	80·7	82·9
XIII.	83·7	81·6	78·5	73·6	63·9	63·2	62·0	67·6	73·9	76·5	82·1	83·8
XIV.	83·9	82·1	79·0	74·0	64·6	64·1	63·1	68·9	73·8	77·1	82·4	84·0
XV.	83·3	82·1	78·9	73·9	64·7	64·1	63·5	69·2	73·9	77·1	81·7	83·9
XVI.	82·4	81·4	78·0	72·9	63·6	62·8	62·4	68·2	73·0	76·1	80·8	83·1
XVII.	81·0	79·9	76·0	69·8	59·3	57·0	57·8	64·8	70·3	74·1	78·5	81·7
XVIII.	79·2	77·1	72·1	65·3	55·2	52·3	52·4	58·5	65·3	70·0	75·3	79·2
XIX.	75·7	73·3	69·0	63·1	53·2	50·0	50·1	55·1	61·8	66·2	71·7	75·3
XX.	73·2	70·9	67·1	61·5	51·7	48·6	48·5	52·9	59·4	63·7	69·1	72·5
XXI.	71·4	69·2	65·6	60·1	50·3	47·3	47·0	51·1	57·3	61·8	67·2	70·6
XXII.	70·1	67·9	64·3	59·1	49·3	46·3	45·8	49·5	55·7	60·2	65·3	68·8
XXIII.	69·0	66·9	63·3	58·1	48·6	45·5	44·9	48·1	54·4	58·9	63·9	67·5
Month	73·9	71·5	68·2	62·8	52·9	50·0	49·5	53·8	60·2	64·7	69·8	73·0